Chemistry 129.01 Quiz #7 – 25 points

Name: Key

1. (6 pts.) Use the following reactions equilibrium constants:

½ $Ni^{2+}_{(aq)}$ + $OH^-_{(aq)}$ ↔ ½ $Ni(OH)_{2\,(s)}$ (1) $K_C = 4.2 \times 10^7$

$H_2O_{(l)}$ ↔ $H^+_{(aq)}$ + $OH^-_{(aq)}$ (2) $K_C = 1.0 \times 10^{-14}$

to find K for the following reaction:

$Ni(OH)_{2\,(s)} + 2\,H^+_{(aq)} \leftrightarrow Ni^{2+}_{(aq)} + 2\,H_2O_{(l)}$ (3) K_C = ?

$$Ni(OH)_{2\,(s)} \rightleftharpoons Ni^{2+}_{(aq)} + \cancel{2OH^-_{(aq)}} \qquad K_1 = \left(\frac{1}{4.2\times10^{7}}\right)^2$$

$$2H^+_{(aq)} + \cancel{2OH^-_{(aq)}} \rightleftharpoons 2H_2O_{(l)} \qquad K_2 = \left(\frac{1}{1.0\times10^{-14}}\right)^2$$

$$Ni(OH)_{2\,(s)} + 2H^+_{(aq)} \rightleftharpoons Ni^{2+}_{(aq)} + 2H_2O_{(l)}$$

$$K = \left(\frac{1}{4.2\times10^{7}}\right)^2 \times \left(\frac{1}{1.0\times10^{-14}}\right)^2 = 5.7 \times 10^{12}$$

2. (4 pts) Consider the following reaction:

$2\,NH_{3\,(g)} \leftrightarrow N_{2\,(g)} + 3\,H_{2\,(g)}$ K = 17

The initial concentrations of reactants and products are: $[NH_3]$ =0.50M , $[N_2]$=0.15M and $[H_2]$=0.12M. Determine the direction in which the system will proceed to reach equilibrium.

$$Q = \frac{[N_2][H_2]^3}{[NH_3]^2}$$

$$Q = \frac{(0.15)(0.12)^3}{(0.50)^2} = 1.0\times10^{-3}$$

$Q < K$ System will proceed right to reach equilibrium.

3. (7 pts.) The following reaction is exothermic.

$$C_6H_{12}O_{6\,(s)} + 6\,O_{2\,(g)} \leftrightarrow 6\,CO_{2\,(g)} + 6\,H_2O_{\,(g)} + q$$

(a) Predict the effect (shift right, shift left, or no effect) of the following:

i. Removing some O_2 from the reaction mixture - shifts left

ii. Adding more $C_6H_{12}O_6$ to the reaction mixture - no effect

iii. Lowering the temperature of the reaction mixture - shifts right

iv. Removing H_2O from the reaction mixture - shifts right

v. Adding a catalyst to the reaction mixture - no effect

(b) How would you change the volume to increase the yield of products?

To increase yield, the system has to shift right. If volume increases, the Pressure will decrease and the system will shift towards more moles of gas (right).

(c) Will the equilibrium constant of the reaction increase or decrease if the temperature is increased?

If the temperature is increased, the system will shift left.

K will be smaller (decrease)

4. (8 pts) Consider the dissolution of silver cyanide in water:

$$AgCN_{(s)} \leftrightarrow Ag^+_{(aq)} + CN^-_{(aq)} \qquad K = 2.2\times10^{-16}$$

(a) Based on the value of K, is AgCN a soluble or insoluble salt? Why?

(b) Write the equilibrium expression for this reaction. Is equilibrium homogeneous or heterogeneous?

(c) Find the $[Ag^+]$ and $[CN^-]$ at equilibrium.

(d) Find K for $Ag^+_{(aq)} + CN^-_{(aq)} \leftrightarrow AgCN_{(s)}$

(a) $K << 1$ Reactants favored $\Rightarrow$ salt is insoluble.

(b) $K = [Ag^+][CN^-] = 2.2\times10^{-16}$

(c)

	$[AgCN]$	$[Ag^+]$	$[CN^-]$
I		0	0
C		+x	+x
E		x	x

$(x)(x) = 2.2\times10^{-16}$

$x = 1.5\times10^{-8}\,M = [Ag^+] = [CN^-]$

(d) $K = \dfrac{1}{2.2\times10^{-16}} = 4.5\times10^{15}$